thereby. Now in elementary geometry it is proved that angles at the center are proportional to the intercepted arcs.

Let $s[L]$, $r[L]$, and θ be the arc, radius, and center angle, s and r being measured in the same *length-unit*, the angle unit being at present undetermined. Then $s[L]=kr[L]\theta$. Let us now *assume* $\theta=1$, *the unit angle, when* $s=r$. Hence, $k=1$, under this assumption. We thus have as our unit angle, $[\Theta]$, the angle at the center of a circle, which intercepts an arc equal in length to the radius of the circle. Hence, we have the general relation $s[L]=r[L]\,\theta\,[\Theta]$ and $\theta[\Theta]=s/r$. This unit angle, $[\Theta]$, is called a *radian*. In terms of the fundamental units of length, mass, and time, it is of zero dimensions, since $[\Theta]=\frac{s[L]}{r[L]}[M^\circ][T^\circ]=L^\circ M^\circ T^\circ$, s being equal to r. From this we see that the great advantage of this unit of angular measure over that of any other is that it avoids, as remarked by Mr. Schmall, the introduction of a *coefficient of variation* different from unity.

PROBLEMS FOR SOLUTION.

ALGEBRA.

329. Proposed by C. N. SCHMALL, 604 East 5th Street, New York City.

Between the quantities a and b there are inserted n arithmetical and n harmonical means, and a series of n terms is formed by dividing each arithmetical by the corresponding harmonical mean. Show that the sum of the series is, $n\left[1+\frac{n+2}{n+1}\cdot\frac{(a-b)^2}{6ab}\right]$.

330. Proposed by R. D. CARMICHAEL, Princeton, N. J.

An important function in the Theory of Numbers is one defined thus: $f(x)=1$ when $x>0$, $f(x)=0$ when $x=0$, $f(x)=-1$ when $x<0$. Two analytic expressions for $f(x)$ are the following:

$$f(x)=\lim_{n\doteq\infty} x^{1/(2n-1)},\ n=1,\ 2,\ \ldots;\quad f(x)=\lim_{n\doteq\infty}\frac{(x+1)^n-(x+1)^{-n}}{(x+1)^n+(x+1)^{-n}},\ x>-1.$$

It is required to find other non-trigonometric analytic expressions for this function. (There are several representations of $f(x)$ by means of trigonometric functions.)

GEOMETRY.

357. Proposed by E. R. HOYT, St. Louis, Mo.

A room is 30 feet long, 12 feet wide, and 12 feet high. At one end of the room, 3 feet from the floor, and midway from the sides, is a spider. At the other end, 9 feet from the floor, and midway from the sides, is a fly. Determine the shortest path by way of the floor, ends, sides, and ceiling, the spider can take to capture the fly.

358. Proposed by H. C. FEEMSTER, A. B., Professor of Mathematics, York College, York, Neb.

Cut four coplanar non-copunctual straight lines in a harmonic range.

CALCULUS.

387. Proposed by C. N. SCHMALL, 604 East 5th Street, New York City.

An object P, being placed beyond the principal focus F of a convex lense, determine its position when its distance PQ, from its image Q, is a minimum.

388. Proposed by L. H. McDONALD, M. A., Ph. D., Sometimes Tutor at Cambridge, Jersey City, N. J.

Find $\int \frac{xdx}{(1+x^3)^{2/3}}$.

MECHANICS.

240. Proposed by G. B. M. ZERR, A. M., Ph. D., Philadelphia, Pa.

A simple beam length $2a$, supported at both ends, is loaded in the form of a parabola, height of vertex b. Find deflection at center due to this load.

241. Proposed by C. N. SCHMALL, 604 East 5th Street, New York City.

In a certain New York theatre there is an asbestos curtain supported by thin circular rings, radius r, which move on a cylindrical rod of radius a. The curtain is intended to be drawn by a *steady pull.* Taking μ as the coefficient of friction, show that this will not be possible if r be less than $a\sqrt{(1+\mu^2)}$.

NUMBER THEORY AND DIOPHANTINE ANALYSIS.

170. Proposed by PATRICK WALSH, 1451 Annunciation Street, New Orleans, La.

The areas of rectangles A and B are respectively 15170 10/27 and 31230.3627. Find the sides and diagonal of each rectangle in exact or rational numbers.

NOTES AND NEWS.

The editors extend to all our readers the Greetings of the Coming Year. We hope that delays in the regular appearance of THE MONTHLT will not occur during 1910. We trust that our subscribers will continue their support and that we may have the immediate renewals of those who have not already remitted their subscriptions for the new year.

On December 23, Editor Miller was married to Miss Cassie A. Boggs. They will make their home in Urbana, Illinois. The other editors and all readers of the monthly extend congratulations to the happy couple.